A State Drought Plan Summary:

A Review of Colorado, Georgia, New Mexico, and Montana Drought Plans

Provided to the Municipal and Industrial Work Group of the Arizona Drought Task Force

Reviews and Critical Summaries Provided by

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Note

This document was generated at the request of Kathy Jacobs of the Arizona Department of Water Resources (now at the University of Arizona). The document is intended to act as guidance for the municipal and industrial water (M&I) work group as they prepare for their initial meeting with stakeholders on October 21, 2003. The document is a first draft and is inten ded to undergo revisions per requests made by the M&I work group chairs and drought task force member. It is requested that Gregg Garfin be contacted prior to this document being made accessible on the Governor's Drought Task Force web page. The reviews of state plans and critical summaries included in this document reflect the guidance given by Kathy Jacobs on which aspects of the state plans to identify, and represent the abilities of the authors to identify and represent these aspects as best as possible.

Each drought plan is reviewed separately. Critical summaries of each plan are provided as a separate section at the end of each review.

1. Colorado Drought Plan Review

1.1 Introduction

Colorado Drought Planning formally began in 1981 and the most r ecent revision to the plan was in 2001. The plan—35 pages long including appendices and references and written in accessible language—includes an executive summary, a history of drought in Colorado, and a description of the steps the state has and will tak e to mitigate and respond to droughts. Other issues addressed in the plan are public outreach and education, sustainability, and long -term drought forecasting and mitigation strategies. Page numbers in parentheses refer to pages in the Colorado Drought Management Plan.

1.2 Plan Development

The Colorado Drought Mitigation and Response Plan is fully developed and implemented; thus, it does not contain an extensive description of the process of developing the plan. It does contain a history of how and why th e plan was initiated in 1981 and a brief review of when it was activated (1989–1990, 1994, and 1996) and reviewed (1986, 1990, and 2001).

1.2.1 Workgroups

There is no description in the plan of the workgroups initially used.

1.2.2 Sectors Addressed

The plan addresses the following sectors:

- Agriculture industry
- Economic impacts
- Energy loss
- Health
- Municipal water
- Tourism
- Water availability
- Wildfire protection
- Wildlife

1.2.3 Vulnerability Criteria

Each of the nine sectors listed above are responsible for assessing vulnerability to drought within their specified domain. However, detailed analyses only occur once the drought plan is activated. As described in the plan, they appear to be somewhat reactive rather than proactive. This is not to say that there is no foresight; those agencies responsible for monitoring drought conditions (see Appendix A1) and advising the governor to activate the drought plan are the same as those responsible for evaluating vulnerability. However , the formal vulne rability analysis appears later in the process.

1.2.4 Climate Divisions

Fundamental to the Colorado plan is the idea that existing local governmental agencies and resources be used to monitor and mitigate drought. The plan declares that, "the plan does n ot create a new government entity to deal with drought, but provides a means for coordinating the efforts of public and private entities that would be called upon to deal with drought impacts" (The Colorado Drought Mitigation and Response Plan, 2001:3).

Local governments (cities, towns, counties) are responsible for

- Designating a drought coordinator,
- Identifying local drought vulnerabilities,
- Reporting through emergency management channels and state agencies.

The plan provides an appendix containing a co ntact list that local governments can use to alert state government of drought -related needs and concerns.

While the plan does not create a state drought entity, it does create several taskforces composed of members from existing agencies. The Governor's Office ultimately decides which task forces are created and may decide not to form a task force, but rather to direct an existing agency to address issues of drought. If a formal task force is formed, it will be one of the following: 1) a Review and Reporting Task Force, or 2) an Interagency Coordinating Group.

Water Availability Task Force
The Water Availability Task Force (WATF) consists of members of local, state, government and private agencies (see Appendix A, Figure 1) and has primary responsibility for monitoring drought indicators and climatological data. In addition to these data they use historical climate records and climate forecasts to make drought forecasts for each of Colorado's basins. Based on these data and analyses the WATF is responsible for alerting the Governor's Office of possible upcoming drought risk.

Impact Assessment Task Forces
Upon an alert by the WATF, the Governor's Office orders the formation of appropriate Impact Assessment Task Forces based on the recommendations of the WAT F. There are nine possible Impact Assessment Task Forces:

- Agriculture industry
- Economic impacts
- Energy loss
- Health
- Municipal water
- Tourism
- Water availability
- Wildfire protection
- Wildlife

If the Governor's Office deems it necessary, a coordinating group, the Review and Reporting Task Force, may be created to organize the efforts of involved task forces and serve as a liaison with the Governor's Office. Each task force is responsible for collecting data, assessing social impacts,

economic losses, costs, and evaluating state and local capacity to respond to the drought. Based on these data, they determine an action plan and report these findings to the Governor's Office.

Interagency Coordinating Group
After review of the reports from the Impact Task Forces, the Governor's Office decides whether to address identified drought -related problems with individual state agencies. In this case, the most affected agency becomes the "lead" agency coordinating their and other state agencies' drought -response efforts. If the drought worsens, or if the Governor's Office deems it necessary, an Interagency Coordinating Group may be formed. The Governor appoints the chair of the Interagency Coordinating Group, and members are drawn from those participating in the Impact Task Forces and from other state agencies. The Interagency Coordinating Group is empowered to take action to respond to drought impacts and, if necessary, to seek federal disaster relief funds. In the past the Interagency Coordinating Group has taken action to remedy economic, environmental, and social problems induced by drought. Examples of these actions include

- Emergency farm loans, assistance finding feed, and herd reduction,
- Urban/wildland interface fire suppression activities,
- Administrate treated wastewa ter use,
- Monitor agricultural groundwater contamination (Pp. 27).

The Interagency Coordinating Group is also responsible for ordering self -dissolution when it deems their activities successful or when current drought conditions disappear.

Natural Hazards Mitigation Council
The Natural Hazards Mitigation Council is responsible for sponsoring and coordinating long -term drought mitigation projects before drought occurs. These activities take different forms as appropriate to identified drought resource gaps . Examples of these activities include

- Technical assistance to the Colorado State University History Department to do a historical study of social drought impacts in Colorado,
- Assisting development of the Standardized Precipitation Index,
- Assisting other states develop drought plans,
- Assisting the Denver Water Board run a drought exercise (Ibid, 18).

The Governor's Office
The Governor's Office is responsible for all disaster relief efforts in Colorado and therefore is the hub among all drought monitoring, mitigation, and response efforts. The Governor's Office plays a mediating role by deciding, based on reports and analyses provided by the groups described above, exactly how to address specific drought conditions. The Governor's Office has sole discretion to elevate the WATF's recommendations to the Impact Assessment stage and to elevate the Impact Assessment Task Forces recommendations to the Response stage. Likewise, the Governor's Office decides how to move through these stages of drought monitoring, as sessment, and response. If conditions are not severe, geographically isolated, or otherwise limited, they can choose to empower existing agencies to respond. However, they also have the latitude to create a formal Interagency Coordinating response group.

1.2.5 Data Needs

The Colorado plan does not discuss precisely what data were needed initially to create their plan, but there is a list of indices and data consulted for monitoring (see below).

1.2.6 Phasing of Plans

The Colorado Drought Mitigation and Response Plan does not discuss how their plan was originally phased in.

1.3 Plan Implementation

1.3.1 Drought Stages

Figure 1 shows the three stages in the Colorado Drought Mitigation and Response Plan . Monitoring is an ongoing process conducted by the WATF and informs the Governor's Office of impending drought. The Governor's Office is then responsible for authorizing movement from Phase 1 to Phase 2 and from Phase 2 to Phase 3. On the other hand, drought taskforces are responsible for deactivating themselves and moving down through the drought stages.

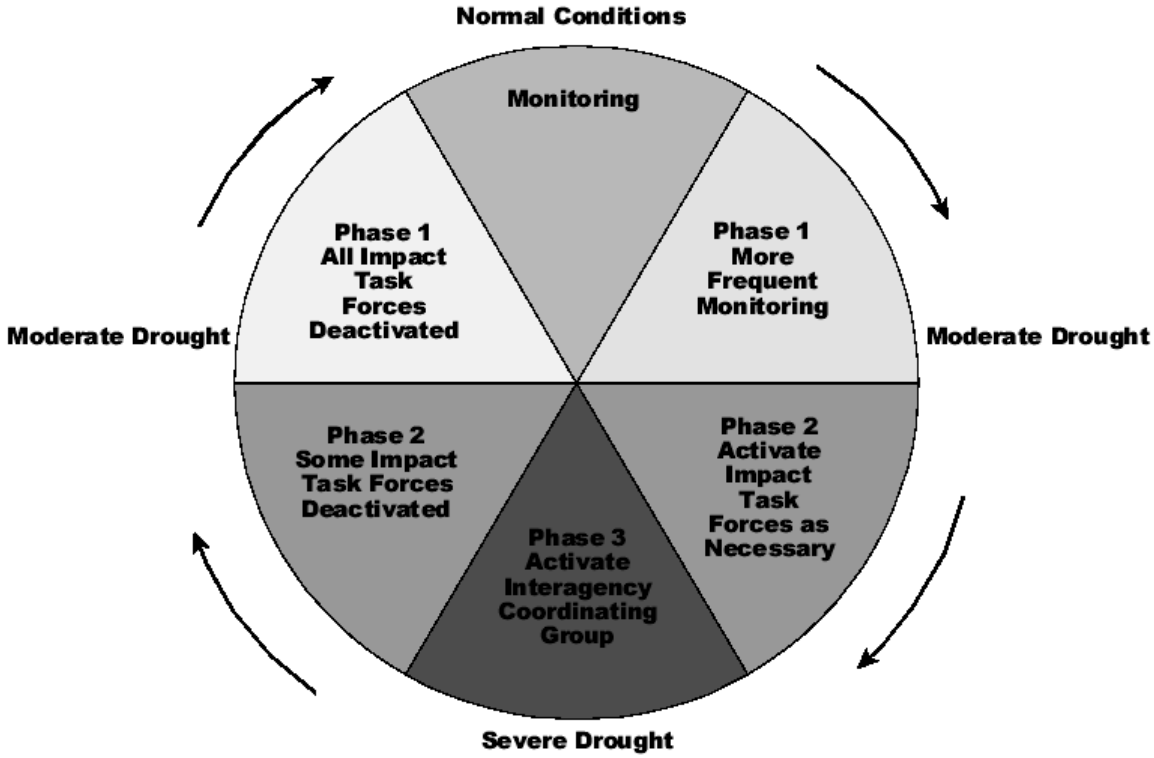


Figure 1. Drought Plan Implementation Cycle (Ibid:11).

1.3.2 Drought Indices

The WATF uses several indices:

- Surface Water Precipitation Index (SWPI)
- Standardized Precipitation Index (SPI)
- Palmer Drought Index (PDI)

1.3.3 Other Drought-Monitoring Data

The WATF uses several other sources of data including:

- Snow pack
- Soil moisture
- Stream flow
- Reservoir levels
- Ground water levels
- Precipitation
- Temperatures

1.3.4 Drought Triggers

Triggering the Colorado Drought Mitigation and Response Plan occurs at the monitoring level by the WATF. It takes the form of a report to the governor requesting that a Drought Impact Assessment be performed. The WATF uses these indicators

- Historical norms
- Modified Palmer Index
- Monthly climate reports
- Monthly Standardized Precipitation Index
- Monthly water supply reports
- Rain gauge sites
- Reservoir levels
- Snow course sites
- Stream flow data
- Surface Water Supply Index
- Weather forecasts

Additionally, the plan provides guidelines for transitioning through the drought phases shown in Figure 1. Figure 2 shows how different PDI, SWSI, and SPI levels trigger movement through drought phases. One issue to note in Figure 2 is that it is more difficult to get into drought than it is to get out of a drought!

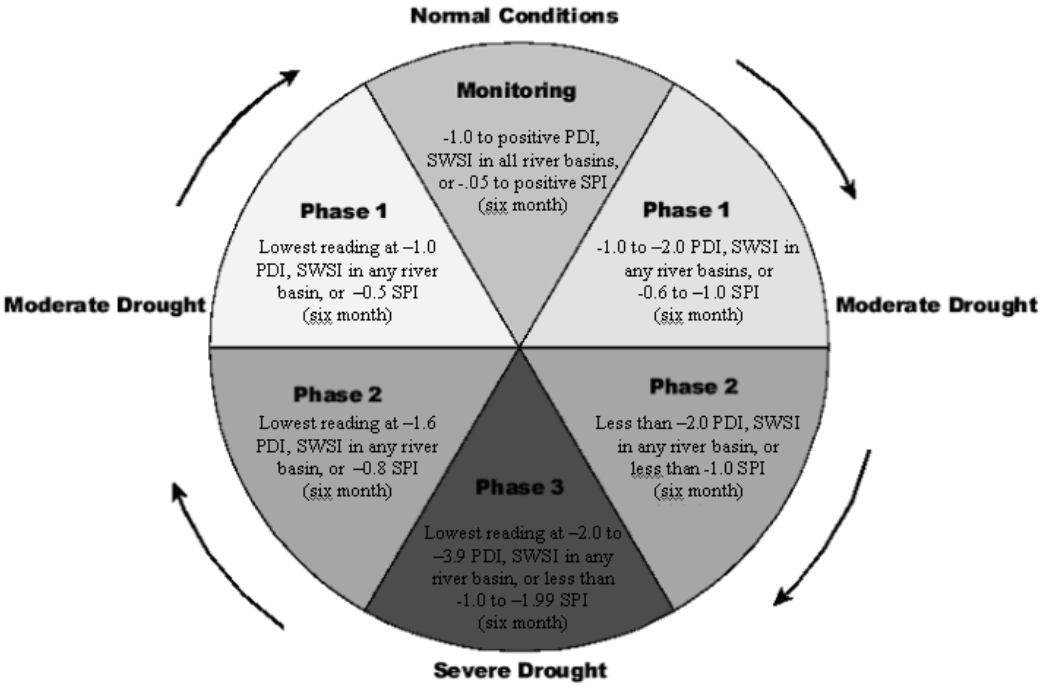


Figure 2. Drought Triggers.

1.3.5 Municipal & Industrial Supplies

The Colorado Drought Mitigation and Response Plan specifies that agencies responsible for municipal and industrial supplies participate on the WATF, Impact Assessment Task Force, and Interagency Coordinating Group.

1.3.6 Involved Agencies

There are many public and private agencies and groups involved with the Colorado Drought Mitigation and Response Plan at all levels of the process (Pp. 24-26).

1.3.7 Financial Assistance

When drought severity reaches the response level, either the lead agency or the Interagency Coordination Group is responsible for seeking federal disaster relief funds. The plan includes an extensive appendix listing state and federal agencies that can provide financial and other forms of support.

1.3.8 Other Assistance

The Interagency Coordination Group provides many different forms of assistance depending on identified problems. See the description above of the Interagency Co ordination Group on page 5 of this report for some examples of how the Interagency Coordination Group offered other assistance to mediate drought impacts.

1.3.9 Feedback and Evaluation

The Colorado plan relies heavily on feedback from local governments t o prepare drought monitoring reports and drought impact assessments. To facilitate this process the plan includes an appendix containing contact information for important drought -related contacts around the state. The plan was first drafted in 1981, and si nce then it has been revised in 1986, 1990, and 2001. The plan commits itself to "periodic" updating (Ibid:20).

1.4 Critical Summary

Colorado obviously makes a strong effort to avoid creating a formal state drought agency. This can be viewed from two per spectives. First, the "democratization" to existing agencies and local governments of drought monitoring and remediation efforts will assist the process of raising the collective consciousness of the ongoing problems related to drought. Local resources wil l be better informed of specific impacts in different parts of Colorado. However, this presumes that existing local governments and agencies have the infrastructure and capacity to exploit state and federal drought-related support; and that those agencies will act in a proactive manner during non -drought periods to remediate drought vulnerabilities.

The WATF is assigned the responsibility for "pulling the trigger" on drought alerts, and the Natural Hazards Mitigation Council is responsible for ongoing mit igation efforts. Both of these organizations are composed of individuals from other state agencies, local government, and other interested parties. According to the plan, none of the participants in these groups are full -time drought researchers. All have other responsibilities in their "home" agencies. This situation could lead to incomplete or overlooked aspects of drought data or mediation efforts in Colorado. The plan does not specify exactly how agencies participating on drought task forces are suppose d to address pre-existing non-drought tasks before, during, and after a drought emergency is declared.

An additional issue that may arise in the plan is that the line of authority over drought -related issues is not clearly defined. In exploiting existing agency resources, the Governor's Office may choose to empower an existing agency (e.g. Parks and Recreation) to deal with a specific drought alert. This potentially could put an agency with little formal experience with drought -issues in charge of drought mediation efforts and result in inadequate or inappropriate response. The Governor's Office has the discretion to empower an existing agency or form an ad -hoc task force to respond to drought events. Over time, or during multiple drought events, this can lead to confusion over who actually has authority during drought.

2. Georgia Drought Plan Review

2.1 Introduction

The Georgia Drought Management Plan was approved on March 26, 2003, by the Georgia Department of Natural Resources Board. The report is the product of a collaboration of 85 citizens with interest and expertise in water issues. The citizens were drawn from business, industry, environmental planning, and water management. The planners also represented a political and geographic cross section. The plan is 23 pages long, and contains sections regarding pre-drought strategies and drought responses. The plan also includes discussion of drought triggers and climate divisions. This summary provides an overview of the areas both covered and neglected in the drought plan, and offers a brief summary. The abbreviations and acronyms used in this summary correspond to those used in the Georgia Drought Management Plan. Page numbers in parentheses refer to pages in the Georgia Drought Management Plan, March 26, 2003. This is the most current version of the plan at the time this summary was written.

2.2 Plan Development

The plan does not offer any history on the development of the plan, but states that the plan requires organizational changes in various state departments to implement the plan (P p. 2). The plan does not indicate the process of implementation or any challenges associated with organizational changes.

2.2.1 Workgroups

There is no description in the plan of the workgroups initially used, however the plan resulted in three sectors (discussed below). Future revisions to the plan will be conducted by a committee. The Director of the Environmental Protection Division (EPD), Georgia Department of Natural Resources, is tasked with assembling a Drought Response Committee (DRC) to analyze the plan periodically and declare drought, if necessary. The DRC is to be chaired by the Director of the EPD and consists of senior managers from the following: Department of Natural Resource's Wildlife Resources Division, Pollution Prevention Assistance Division, and Coastal Resources Division. Also, state representatives from Georgia's Department of Community Affairs, Department of Agriculture, Emergency Management Agency, Forestry Commission, Soil and Water Conservation Commission, and Office of the State Climatologist (OSC) will participate on the DRC. The following organizations and federal agencies shall have representation, as well: Atlanta Regional Commission, Georgia Urban Agriculture Coalition, United States Army Corps of Engineers, United States Geological Survey, United States Fish and Wildlife Service, one regional development center, one non-governmental organization, one representative organization of the business community, and one representative organization of the agricultural community (P p. 5).

2.2.2 Sectors Addressed

The plan addresses three sectors

- Municipal and Industrial
- Agriculture
- Water Quality, Flora, and Fauna

The plan does not explain the limits of each sector, and the overl ap, if any, of these sectors. There is no consistent structure in the addres sed points under each sector (e.g. . state, regional, local). Strategies and responses are tailored specifically for each sector.

2.2.3 Vulnerability Criteria

The plan does not discuss vulnerability at any level. The plan addresses "at risk" landscapes (crops, golf courses, forests, etc .), but does not discuss geographic areas or specific responsibilities in calculating vulnerability of zones or specific landscapes.

2.2.4 Climate Divisions

The State of Georgia is divided into nine climate divisions (Pp. 23). Each climate division has several drought indicators that are monitored by the State Climatologist's office and the EPD. If any region passes a prescribed condition for two consecutive months, the state climatologist office will begin a preliminary investigation . As the conditions escalate, t he Director of the EPD is assigned the responsibility to organize a Drought Response Committee to further analyze the information a nd declare drought in appropriate climate divisions.

2.2.5 Data Needs

The plan is based on data from stream flows, lake/reservoir levels, precipitation, groundwater levels, and other climate information that is provided by cooperating agencies. Coopera ting agencies are principally the US Army Corps of Engineers, US Geological Survey , and the National Drought Mitigation Center (Pp. 4,19).

2.2.6 Phasing of Plans

The Georgia Drought Management Plan does not discuss phasing of the plan. Upon approval of the plan, cooperating agencies and state departments are encouraged to organize appropriately as soon as possible.

2.3 Plan Implementation

2.3.1 Drought Stages

Declared drought can occur at four stages, with Stage 1 being the most mild and 4 being the m ost severe. The stage of the declared drought triggers a level of response, corresponding to the level of drought (P. 20).

2.3.2 Drought Indices

The nine climate divisions are individually monitored by using the Standardized Precipitation Index (SPI) at 3, 6, and 12 months (P. 19). This index compares the amount of precipitation for the previous 3, 6, or 12 months to the same months historically.

2.3.3 Other Drought-Monitoring Data

In addition to the 3 -, 6-, and 12-month SPI, each climate division is assigned a unique combination of reservoir levels, groundwater levels, and stream flow. The assignments are determined relative to

the geography of the climate division. Some climate divisions may use the same indicators (e.g., a river that is the boundary of two or more climate divisions).

2.3.4 Drought Triggers

The four indicators (precipitation, reservoir levels, groundwater levels, and stream flow) are calculated into percentiles every month. In addition, reservoir levels are analyzed in rule curves, and stream flows are examined in terms of average annual discharge and monthly 7Q10. The values produced for each indicator may place the indicator into a drought stage.

The appearance of an indicator in a drought stage does not necessarily trigger a declared drought. When any one of the triggers for any one climate division is at a more severe level for two consecutive months, the EPD will conduct an evaluation into whether or not to declare/escalate a drought level. The triggers DO NOT indicate drought themselves—they only trigger action by the EPD to investigate the possibility of a new/escalating drought (P p. 21). Drought can be declared in one or more climate divisions, depending on the findings of the DRC. The geographic extent of the drought is to be explained in the drought declaration .

Like the process of entering a drought, getting out of a drought is a function of triggers and investigation by the EPD. When all triggers for a particular climate division are at a less severe trigger level for four consecutive months, then the EPD will conduct an investigation to declare an improving drought condition or declare an end to the drought.

For a thorough discussion of the calculation of drought triggers, please refer to Appendix B .

2.3.5 Municipal & Industrial Supplies

The municipal and industrial sections of the Georgia Drought Management Plan are discussed in great detail in Appendix B .

2.3.6 Involved Agencies

There are many agencies and departments within Georgia that participate and are assigned responsibilities in the Georgia Drought Management Plan. The agencies are referenced throughout the document, but are not comprehensively summarized. Many agencies share responsibilities, while some responsibilities are the sole domain of one agency. One should reference the plan for specific inquiries into the involvement of an agency or department into a specific action.

2.3.7 Financial Assistance

The Georgia Drought Management Plan recommends incentives and actions that require funding. The responsibility of securing funding rests with the department or agency assigned the task that requires funding. It is assumed that these department and agencies will have to create budgeted items for these responsibilities.

2.3.8 Other Assistance

The Georgia Drought Management Plan does not outline specific assistance provided to cooperating departments, agencies, local governments, etc. However, the plan repeatedly calls for free communication and interaction between state and local governments regarding local plans and strategies.

2.3.9 Feedback and Evaluation

The DRC will review the plan at least every five years and after every drought event. The plan does not offer specific channels of feedback from citizens or stakeholders. The DRC is crafted to include the voices of a diverse collection of interests and expertise.

2.4 Critical Summary

At only 23 pages, the Georgia Drought Management Plan looks fairly straightforward. But despite the relative short report, Georgia is able to identify what they think are the most important steps in declaring a drought and managing water resources during a drought. In the declaration process, Georgia uses a percentile system of drought indicators to normalize each climate division, providing a fairly accurate historical perspective on conditions at the climate division level. It takes only two months of drought conditions to enter an entry-investigation phase, but four months of improving/non-drought conditions to initiate an exit-investigation. The investigation phase is, perhaps, the most important element of the drought declaration process. The drought triggers indicate a possible drought condition, and trigger the formation of the DRC. The committee is composed of over 17 representatives from federal, state, and non-profit agencies. So, despite the great effort to capture a picture of a possible drought through mathematics, Georgia still requires input and feedback from experts culled from a cross-section of government and industry.
There are some neglected areas in the plan. Most glaring is the inconsistency of details across the different areas of the plan. For example, every sector is addressed in the pre-drought strategy sections, but there is no mention of how/when/from where the money will come from to address the many tasks assigned to various agencies. Also, the plan discusses the power of the EPD Director and the membership of the DRC, but does not explain in great detail the powers that representatives on the DRC may wield. The plan only asserts that the EPD Director may declare drought after consultation with the committee (P p. 4). In the drought response sections, the plan outlines very specific restrictions on water use, yet does not address the policy of enforcement. One may assume that local jurisdictions will be responsible for implementing the responses, but this is not explicitly stated. Finally, the drought trigger section does not discuss the exclusive use of the SPI. With several indices available, one would expect use of several, or a discussion of why only one index is appropriate.

3. New Mexico Drought Plan Review

3.1 Introduction

In 1996 a drought emergency plan was developed for the state of New Mexico, followed in 1998 by the beginning of a drought planning process that continues today. According to the plan, the purpose of the process and current drought plan is to provide New Mexico with a framework for an integrated approach to minimize the impacts of drought on its people and resources. The plan outlines both long- and short-term measures that are to be used to mitigate the effects of drought and respond to drought conditions. In designing the action strategies of the New Mexico Drought Plan, effort was made to use existing partnerships and lines of communication and the input of local New Mexico stakeholders in providing feedback as to the effectiveness of planned or implemented mitigation measures. Page numbers in parentheses refer to pages in the New Mexico Drought Management Plan. For more on drought plan background information see the New Mexico drought plan revised on 5-31-02, section 2 (http://weather.nmsu.edu/drought/053102/)

3.2 Plan Development

The development of a comprehensive drought plan began in 19 98. Since then, the drought plan has been revised in May 2002 and again in November 2002 (Volum e 2). The plan is available in PDF format (requires adobe acrobat reader software) on the internet and the reader is referred to sections accessible via the web. For more on plan development see the New Mexico drought plan revised on 5-31-02, section 2 (http://weather.nmsu.edu/drought/053102/).

3.2.1 Workgroups

The New Mexico Drought Task Force (DTF) is co mposed of cabinet secretaries of the New Mexico Department of Agriculture, Department of Energy, Minerals and Natural Resources, Department of Public Safety, the State Engineer , and a member of the Office of the Governor.

The Monitoring Work Group (MWG) a ssesses drought status to assist the DTF and t he Impact Assessment Work Group (IAWG). As necessary, the MWG issues "notices" based on various stages of drought that "trigger" actions by the IAWG and the DTF. While the MWG accesses a variety of types and so urces of information pertinent to monitoring drought conditions, three primary indices are used to designate drought status (and therefore actions conducted by the IAWGs): the Palmer Drought Severity Index (PDSI), the Surface Water Supply Index (SWSI), and the Standardized Precipitation Index (SPI).

IAWGs serve two functions. First, when the state is not in a drought, the IAWGs work year -round to assess vulnerabilities to drought and take action to mitigate those vulnerabilities. Second, during a drought, the IAWGs play the critical role in assessing the actual impacts of drought in the affected areas of the state, communicating those impacts to the DTF , and, where possible, taking action to respond to and alleviate the impacts of the drought. However, beca use of the limited capabilities of the sub-group members, it is also incumbent upon them to make recommendations to the DTF on actions that should be taken at other levels of government to respond to the drought situation. The Task Force also should be adv ised of any needs that cannot be met through existing in -state resources.

Each of the IAWGs are responsible for assessing drought vulnerabilities and developing and implementing drought mitigation strategies. These include actions that can be taken before a drought event to prevent, where possible, drought impacts from occurring or lessening their severity. The four groups have analyzed vulnerable sectors of their respective impact groups and have developed numerous preventative action strategies that will mitigate the effects of drought on their target sector (see Appendix C). Where possible, the sub-groups will implement the strategies identified. When the sub-group lacks the authority or jurisdiction, they will work with the DTF to implement the actions.

A Water Trust Board has been established to authorize funding for qualifying water projects that address a set of predefined guidelines (see table 1b, page 4 of Volume 2)

Relevant IAWG: The Drinking Water, Health and Energy IAWG
The Drinking Water, Health and Energy IAWG has a broad-spectrum of mitigation and response responsibilities. Drought-related impacts on drinking water systems, energy delivery systems, and public health conditions are the purview of this sub-group. For example, as droughts worsen, municipal water systems can become increasingly strained. Water quantity and quality problems can become a crisis within certain communities that lack contingencies for drought. In addition, although drought is a climatic condition associated with an unusual and prolonged lack of precipitation, higher than normal temperatures also may be a related concern. Therefore, drought conditions may cause unusual demands on electrical and other energy systems, possibly resulting in brown-outs and grid failure. Finally, the health aspect of drought may include a variety of issues including respiratory problems associated with blowing dust and mental health concerns due to economic failure.

A relational chart of the structure of the DTW, MWG and IAWGs is provided in Appendix C.

For more on workgroups and the structure of the drought planning and response process, refer to volume 2 of the New Mexico drought plan, Table 1b (http://weather.nmsu.edu/drought/Drought-plan1112002/Volume-2.pdf).

3.2.2 Sectors Addressed

The New Mexico drought plan addresses sectors via the IAWGs. The sectors addressed are provided in Appendix C of this document.

3.2.3 Vulnerability Criteria

The New Mexico plan identifies those engaged in activities relying solely on rainfall and/or soil moisture are the most vulnerable to drought. Still at relatively high risk, but somewhat less exposed, are those water uses depending on in-stream flows, which includes run-of-the-river irrigation, aquatic, wetland and riparian environmental communities, and recreational water uses. Less exposed to the risks of drought in New Mexico are many urban and agricultural water users who rely on surface water reservoir supplies or on groundwater resources that are not dependent on high rates of aquifer recharge or adversely affected by concentrated levels of high pumping. The level of risk, which includes vulnerability and hazard, has been considered in the design of the structure of the New Mexico Drought Plan and is integrated into the planning, mitigation, and response activities of the plan.

3.2.4 Climate Divisions/ Drought Management Areas

Drought status can be evaluated separately in each of eight climate divisions in New Mexico, based on the drought data and indices used (see Drought Monitoring Indices/Data section below).

3.2.5 Phasing of Plan

The plan has been fully implemented and aspects of the drought plan have been in action since 1998.

3.3 Plan Implementation

3.3.1 Drought Stages

New Mexico established five categories for drought status. The drought status levels are determined by drought data and indices listed below. Drought status is evaluated for each climate division. A table of drought status levels and associated drought index levels used to establish drought status is provided in Appendix C.

For more on drought stages see the New Mexico drought plan revised on 5-31-02, section 7 (http://weather.nmsu.edu/drought/053102/).

3.3.2 Drought Monitoring Indices/Data

A variety of sources and types of monitoring data are used for assessing drought status, including

- Meteorological data from the National Weather Service,
- Snowfall and stream flow forecast data from the Natural Resources Conservation Service,
- Stream flow data from the US Geological Survey,
- Reservoir storage data from the New Mexico Streams Commission,
- Crop status and soil moisture data from the New Mexico Department of Agriculture.

Indices used to establish drought status include

- The Palmer Drought Severity Index,
- The Surface Water Supply Index,
- The Standardized Precipitation Index.

For more information on drought monitoring data and indices see the New Mexico drought plan revised on 5-31-02, section 6 (http://weather.nmsu.edu/drought/053102/).

3.3.3 Drought Triggers

The MWG will assess the information and indices discussed above and in combination with other available real-time information determine the status of drought in each climatic region in New Mexico.

A table of IAWG actions dependent on drought status and trend (i.e., increasing or decreasing drought severity) is provided in Appendix C.

3.3.4 Agency Responsibilities

Each IAWG has established action plans to be implemented to mitigate drought vulnerabilities. These action plans, however, do not represent steps to be taken by agencies or groups at particular stages of a drought. It is assumed that actions taken by agencies or groups during drought (e.g., restrictions, enforcement) are established on a case-by-case basis and are determined as conditions warrant such actions. Action plan steps established by the drinking water, health and energy IAWG are provided in Appendix C.

For more on agency responsibilities and IAWG action plans, refer to volume 2 of the New Mexico drought plan, Table 5 (http://weather.nmsu.edu/drought/Drought-plan1112002/Volume-2.pdf).

3.4 Critical Summary

The New Mexico Drought Plan has been revised (at least) twice since its initial creation. The plans are most easily accessed on via the internet. However, the website where the plan(s) are provided, as well as the PDF documents themselves are in need of updating for ease of use and accessibility. Currently (as of October 15, 2003), the main New Mexico drought planning team website (http://weather.nmsu.edu/drought/) provides a link to the plan that was initiated in 1998 (not indicated when it was completed), a link to the plan that was updated in May of 2002, and an additional link to a plan that was updated in November of 2002. The structure of the May 2002 and November 2002 documents are different (entirely PDF versus weblinks to PDF sections), and some parts of the May 2002 document are not present in the November 2002 document (i.e., the updates are not cumulative). This makes it difficult to assure that information is current and creates uncertainty for research on the New Mexico plan for other states.

The task force, monitoring group, and sub-groups have a fairly simple and functional structure. While each IAWG is providing annual reports and recommendations to reduce drought vulnerability in the interim between droughts, the degree of activity of the IAWGs, and the DTF in general is largely determined by the drought status set by the MWG. Therefore, there is a somewhat constant level of action and work taking place regardless of drought status, but as drought status worsens (as well as when it improves) there are specific actions that all IAWGs must take according to the drought plan. It is important to reiterate that according to the plan, the activity level of the DTF and the IAWGs is entirely dictated by the drought status set by the MWG.

The drought plan does not include specific actions that agencies will implement (e.g., see Georgia drought plan) in the event of a drought or level/duration of drought conditions. It is possible that actions have been established/taken in the past but they are not indicated in the plan. Assuming the absence of mandatory or voluntary actions taken in the plan(s) is intentional, it is concluded that the planning process activates the necessary people in government agencies and on the DTF and IAWGs and it is at this point actions to reduce water demand are considered and implemented.

The planning process has also included the establishment of a Water Trust Board to authorize funding for qualifying water projects that address a set of predefined guidelines. This aspect of the planning and response process is interesting, in that it explicitly includes the means to approve funding of projects that directly pertain to reducing drought vulnerability during and in between droughts. However, it is not clear how the board is funded.

4. Montana Drought Plan Review

4.1 Introduction

The Montana Drought Response Plan was last revised in 1995. The plan is rich in details and presents useful structures for understanding and planning for drought conditions and for mitigating drought impacts. The plan includes extensive appendices, including organizational responsibilities, memos, permits, and other documents related to drought that may be helpful designing the Arizona Drought plan. Page numbers in parentheses refer to pages in the Montana Drought Management Plan.

4.2 Plan Development

Due to significant periods of below -average precipitation in 1985, 1986, and 1988, Montana passed the Montana Drought Response Plan in 1991. As an active plan, it does not contain specific reference to the exact workgroups, organizational structures, or other mechanisms used to create the plan. It does include, however, an interesting appendix that lists eight issues identified by the Steering Committee responsible for drafting the original plan. These quest ions are included in Appendix D, for reference.

4.2.1 Sectors Addressed

The plan addresses the following sectors

- Dryland Farming
- Energy Production
- Fish and Wildlife Wildfire
- Irrigation Water Supplies
- Livestock Operations
- Municipal and Domestic Water Supp lies
- Public Lands
- Recreation
- Secondary Commerce*
- Tourism

(* The plan defines secondary commerce as: "Secondary businesses include those with customers that have been directly affected and whose ability to spend has been reduced" [Pp. 20].)

These sectors are addressed by one or more state agencies. Exactly which agencies are responsible are described in detail on pages 27 -51 and 52-80.

4.2.2 Vulnerability Criteria

Each of the sectors (and their respons ible agencies) listed above are responsible for spec ifying exactly how they are vulnerable to drought. However, the plan appears to lack a consistent definition of drought vulnerability that spans across sectors. Each sector has an "annex" included Appendix A of the Montana drought plan (not provided here) that outlines their vulnerabilities to drought and specifies actions to take in case of drought.

4.2.3 Climate Divisions

The Montana Plan attempts to use existing state and local bureaucracies to cope with drought, when possible. There does not appear to be a reference in the plan to specific geographic climate divisions within the state. However, since it is the responsibility of various state agencies to report on drought conditions as they affect the sectors in section 4.2.1, it is likely that these agencies use the geographic boundaries common to their existing internal systems.

In order to coordinate the activities of these diverse organizations, the state created a Drought Advisory Committee, which is the central source of drought-related organizational tasks.

Drought Advisory Committee
The Drought Advisory Committee consists of a chairperson assigned by the Governor's Office and representatives from several state agencies including: departments of natural resources and conservation; agriculture; commerce; fish, wildlife, and parks; military affairs; health and environmental sciences; state lands; and livestock (Pp. 6). Additional non-voting members may also attend meetings. The Drought Advisory Committee has the following responsibilities:

- With the approval of the governor, develop and implement a state drought plan,
- Review and report drought monitoring information to the public,
- Coordinate timely drought impact assessments,
- Identify areas of the state with a high probability of drought and target reporting and assistance efforts to those areas,
- Upon request, assist in organizing local drought advisory committees for the areas identified under section c,
- Request state agency staff to provide technical assistance to local drought advisory committees,
- Promote ideas and activities for groups and individuals to consider that may reduce drought vulnerability.

The Drought Advisory Committee holds meetings in February and October and delivers a Drought Status report to the Governor by March 15 of each year.

Local Drought Advisory Committees
When the Drought Advisory Committee reports to the Governor's Office every March 15, they may recommend areas of the state that are particularly vulnerable to drought. The committee then recommends the formation of a Local Drought Advisory Committees in these vulnerable areas. The purpose of the Local Drought Advisory Committees is to facilitate information exchange between the county and the Drought Advisory Committee. Primary activities of the Local Drought Advisory Committees include monitoring, reporting, assessment, and response. To aid in this task, the Montana State Drought Response Plan includes an "Operations Manual For Local Drought Mitigation" (Pp. 122-133). The Plan also calls for the Local Drought Advisory Committees to engage in, "long-term activities to be prepared for drought" (Pp. 9).

It is worth noting that there appears to be a conflict between local, long-term planning, and the fact that Local Drought Advisory Committees only form after the state enters a Drought Alert (see below for a description of the drought stages).

Department of Natural Resources
The Department of Natural Resources is responsible for fulfilling staffing needs to the Drought Advisory Committee. As such, this department has many responsibilities involved with drought planning, monitoring, and mitigation. These responsibilities are described in detail on pages 28–31 in the Montana Drought Response Plan. Their responsibilities include:

- Administer and staff the Drought Advisory Committee,
- Publish the Water Supply and Moisture Report,
- Provide grants and loans to promote efficient use of water,
- Monitor building within floodplains,
- Sponsor and coordinate water-use awareness programs with other organizations,
- Assist other local organizations and irrigation districts develop drought plans,
- Process temporary water right transfer requests'
- Implement a "Water Use Conflict Resolution Policy."

Of particular interest is the "Water Supply and Moisture Condition Report." This report is published monthly from February to October unless there is abundant moisture present. It contains a summary of the state's weather for the previous month and includes the following data:

- Federal reservoirs
- Mountain precipitation
- Palmer Drought Severity Index
- Snowpack
- Soil moisture
- State reservoirs
- Stream flow
- Surface Water Supply Index
- Weather forecasts

A sample "Water Supply and Moisture Condition Report" is included on pages 134–47 of the Montana Drought Response Plan.

Other State Agencies
Many other federal, state, and local agencies have responsibilities designated in the Montana Drought Response Plan. Please refer to Appendix D, for a complete list.

4.2.4 Data Needs

The Montana Drought Response Plan employs multiple sources of data. During Drought Advisory Committee meetings (see section 4.2.3) state and federal agencies involved report on temperature and precipitation forecasts, mountain snowpack and precipitation, soil moisture, stream flow, reservoir levels, and fire conditions. In addition to these data, the regular monitoring of drought conditions includes assessing Palmer Drought Severity Index and Surface Water Supply Index values.

4.2.5 Phasing of Plans

The Montana Drought Response Plan does not discuss how their plan was originally phased in.

4.3 Plan Implementation

4.3.1 Drought Stages

The Montana Drought Response Plan has a simple three -stage drought monitoring and response framework. The three stages are

- Monitoring
- Drought alert
- Severe drought

Monitoring is an ongoing process conducted by many agencies and coordinated by the Drought Advisory Committee and by the Department of Natural Resources and Conservation. The primary instrument of drought monitoring is the "Water Supply and Moisture Condition Report" produced monthly (February to October) by the Department of Natural Resources and Conservation. This report is used by other agencies to evaluate drought risk.

4.3.2 Drought Indices

The two drought indices used in the Montana Drought Response Plan are the Palmer Drought Severity Index (PDSI), and the Surface Water Supply Index (SWSI).

4.3.3 Other Drought-Monitoring Data

Other data used drought con ditions are

- Federal reservoirs
- Mountain precipitation
- Snowpack
- Soil moisture
- State reservoirs
- Stream flow
- Weather forecasts

4.3.4 Drought Triggers

Transitions between these stages are determined by the PDSI, and the SWSI in conjunction with other climatological data. Figure 1 shows the PDSI and SWSI thresholds necessary to trigger each drought stage.

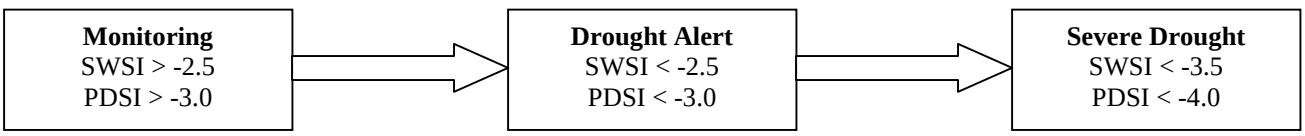


Figure 1. Drought Plan Stages.

One observation about the drought triggers is that the plan does not specify exactly how the state comes out of a Drought Alert or Severe Drought to return to normal monitoring. The plan alludes to the need for a "quantitative" measure of drought with "flexibility" but without too much "discretionary latitude" (Pp. 21). While the plan does specify the quantitative measures (PDSI, SWSI) and how they should be used, it does not seem to provide a formal mechanism for incorporating "flexibility" while avoiding " discretionary latitude." Presumably, the plan's authors felt that the Drought Advisory Committee meetings were the setting for these contextualized dynamics to play out. However, the plan does not specify the relationship between drought indices and the advisory committee's opinion on a particular drought scenario.

4.3.5 Municipal & Industrial Supplies

During a Drought Alert or Severe Drought, the Department of Environmental Quality is responsible for preparing monthly assessments of municipal water supplies. These assessments are delivered to the Drought Advisory Committee for incorporation in its Drought Status report to the governor. In addition, the Department of Environmental Quality must assist local communities in monitoring their own municipal water supplies and with grants and loans, when necessary. Please refer to page 18 in the Montana Drought Response Plan for a complete description of Municipal and Domestic Water Supplier responsibilities. Also, page 123 contains information intended to help Local Drought Advisory Committees address issues related to private and municipal water supplies.

4.3.6 Involved Agencies

Appendix D contains a complete list of the federal, state, and local agencies, private organizations, and other entities involved in drought response.

4.3.7 Financial Assistance

The plan states that, "all costs are borne by the member agency or organization" (Pp. 9) and that no funding is provided to the Drought Advisory Committee. Emergency funding can be sought by individual agencies through the Governor's Office and from federal sources.

4.3.8 Other Assistance

The Montana State Drought Response Plan includes many extensive appendices containing documents related to drought preparedness, including: permits, forms, preparation manuals for local communities, and contact information for those involved with drought planning, response, and mitigation. State agencies, especially the Department of Natural Resources and Conservation, are available to local communities and other agencies as a resource in drought preparation, response and mitigation.

4.3.9 Feedback and Evaluation

There is no reference in the Plan to ongoing revisions or feedback mechanisms into the structure of the plan, itself.

4.4 Critical Summary

Montana's Drought plan is interesting in part because it acknowledges some of both the bureaucratic and psychological difficulties that pertain to drought planning:

> The responsibility for the failure of drought plans to achieve identified goals lies less with the plans than with decision makers who lacked the resolve to implement elements of the plans. Much of this has to do with the psychology of drought management. While it is known that drought will occur again, measures that would lessen our vulnerability to drought in the long and short-term are often overlooked or dismissed. Similarly, while in the midst of a drought, it is certain that someday rains will return and the state will have survived drought once again. This attitude causes people to delay doing the sometimes -difficult things that could lessen detrimental impacts of drought in the short -term. (Pp. 4)

The plan emphasizes pro-activity. The plan suggests that drought provides more advanced warning than other natural disasters and therefore, through thoughtful plan ning and commitment, it is possible that the consequences of drought can be significantly reduced (Pp. 3).

The plan also emphasizes local control. It suggests that the state should provide technical support and play a coordinating role and individuals an d local government will most effectively mitigate drought consequences.

The plan also is notable because it contains a formal procedure for resolving water -use rights conflicts during times of drought.

While the plan's focus on proactivity and local con trol is admirable, the structure of the plan, as written, does not always reflect these ideals. State -level organizations only encourage local organization once a drought emergence is declared —not before. Nor is any drought-related non-emergency funding pr ovided to either local or state organizations for proactive drought.

Despite these qualifications, the Montana Drought Plan will be a very useful reference for members of the Arizona Governor's Drought Task Force.

List of References

Colorado State Drought Plan:

http://www.dola.state.co.us/oem/Publications/droughtplan.pdf

Georgia State Drought Plan:

http://www.drought.unl.edu/plan/state%20plans/Georgia.pdf

New Mexico State Drought Plan:

http://weather.nmsu.edu/drought/053102/ (plan drafted on 5-31-02)

http://weather.nmsu.edu/drought/Drought-plan1112002/Volume-2.pdf (Volume 2, drafted on 11-21-02)

Montana State Drought Plan:

http://nris.state.mt.us/wis/DroughtP.pdf

Note: this link is provided on several Montana state agency pages (and on the National Drought Mitigation Center site, too) but as of October 15 is a broken link. The plan can also be accessed via the Montana state library website (http://msl.state.mt.us/) using the Following keywords: "Montana Drought Plan".

Appendix A: Colorado Drought Plan

A1. Drought Monitoring and Mitigation Entities .

	Participating Organizations	Tasks
Water Availability Task Force	Colorado Office of Emergency Management Office of the State Climatologist Colorado Division of Water Resources Colorado Water Conservation Board National Weather Service National Resources Conservation Service U.S. Geologic Service Bureau of Land Management Bureau of Reclamation private parties	Monitor drought forecasts and climate conditions Make projections based snow pack, soil moisture, stream flow, reservoir levels, groundwater levels, precipitation, temperatures, Surface Water Precipitati on Index, Standardized Precipitation Index, Palmer Drought Index Determine requirements for routine and special reports Communicate with and provide special data to other task forces Identify resource gaps and make recommendations to address them

Appendix B: Georgia Drought Plan

B1. Calculation of Drought Triggers.

• Drought triggers are specific values of indicators that help to determine when each level of drought response should begin or end. This plan contains four levels of increasing severity. A level is triggered when an indicator value reaches a certain percentile. By using percentiles, multiple indicators can be compared and combined within a consistent framework. Additional triggers are developed for reservoir levels based on zones, and streamflows based on average annual discharge (AAD) and monthly 7Q10 (M7Q10).

• Triggers are used for both going into a drought and coming out of a drought. Note that triggers do not automatically invoke a level and required response. Rather, the triggers prompt an evaluation about the possible need to declare a certain drought response level and take appropriate measures.

• Going into a drought: When any one of the triggers for any one of the CDs is at a more severe level for at least two consecutive months, then an evaluation is conducted about whether to increase the level of response.

• Getting out of a drought: When all of the triggers for that CD are at less severe level for at least four consecutive months, then an evaluation is conducted about whether to decrease the level of response.

Conditions	Percentiles for All Triggers: Precipitation, Reservoir Levels, Groundwater Levels, Streamflows
Level 1	0.20 – 0.35
Level 2	0.10 – 0.20
Level 3	0.05 – 0.10
Level 4	0.00 – 0.05

Conditions	Reservoirs Levels: Rule Curves
Level 1	< Zone 1
Level 2	< Zone 2
Level 3	< Zone 3
Level 4	< Zone 4

Conditions	Streamflows: AAD / M7Q10
Level 1	< 80/60/50 % AAD
Level 2	< M7Q10 + (2/3)
Level 3	< M7Q10 + (1/3)
Level 4	< M7Q10

B1 (cont.). Calculation of Drought Triggers .

The four levels of this plan were based on percentiles, relative to each month. This approach was designed to provide statistical comparability among indicators, temporal and spatial consistency, and ease of interpretation. For instance, percentiles can be related to probabilities of occurrence, and used to compare current conditions with historic conditions.
The indicators were selected through an analysis of several hundred combinations, using actual data, to generate the triggering sequences that would have occurred historically. These sequences were then compared to retrospective assessments of conditions in each of the climate divisions, and in each of the sectors of municipal and industrial, agriculture, and environmental, to determine the indicators and triggers that would have performed the best for the periods before, during, and after a drought.

To transform indicator data to percentiles, the following procedures were used:

• For precipitation, percentiles were calculated directly from the SPI value, which is a statistical Z-score, for each climate division. The SPI-3, -6, and -12 represents total precipitation during a 3, 6, and 12 month period, relative to those same months historically. Percentiles can also be determined by fitting a gamma distribution to the long-term record, and then determining 3, 6, and 12-month anomalies, relative to the historic record.

• For reservoir levels, percentiles were calculated using an empirical cumulative distribution function, which is a ranking procedure using the historic record of data, analyzed by each month. In addition, reservoir triggers were based on reservoir rule curves, and levels were associated with each of the zones.

• For groundwater, percentiles were calculated from U.S.G.S. duration analyses for probabilities of exceedance, using detrended data, and triggers were based on the most severe level for a majority of the selected wells.

• For streamflows, percentiles were calculated from empirical cumulative distribution functions, using long-term and equivalent records of average flow data, analyzed by each month. In addition to percentiles, an algorithm using average annual discharge (AAD) and monthly 7Q10 (M7Q10) was used for streamflow triggers. Here, delta (D) is the difference between 80/60/50% AAD and M7Q10, and 80/60/50% refers to 80%AAD for January through April, 60%AAD for May, June, and December, and 50%AAD for July through November.
Through evaluations of the drought plan and its performance (Section IC, it is likely that indicators, trigger levels, data sources, and calculation methods may change. This drought plan is designed to remain flexible, and to accommodate procedures that would provide the most useful guidance and ability to minimize the adverse impacts of drought.

B2. Municipal and Industrial Sections of the Georgia Drought Management Plan .

Pre-Drought Strategies

" 'Pre-drought strategies' are longer-term actions, implemented before a drought, for the purposes of preparedness, mitigation, monitoring, and conservation."

1. State Actions

There are 13 steps that the State of Georgia has identified. Most of the actions concern the institutional structure that needs to be in place to adequately respond to a drought (drought response committee, communications system, local drought plan review, and a long term conservation program). There are also steps that concern education and encouragement of water conservation. These steps require state government to work with local water providers, industry, and golf courses. In addition, the plan calls for funding of research into drought and its impact on water-dependent industry, with the aim to develop assistance programs and improve predictability of drought impacts. Specifics on the nature of education are not discussed (what media, what levels?). Every task has been assigned to one or more state offices or agencies depending on the knowledge and/or abilities of the office or agency. The offices involved are:

- Environmental Protection Division, Georgia Department of Natural Resources
- Office of the State Climatologist
- Cooperating Entities
- Department of Natural Resources
- Pollution Prevention Assistance Division
- Georgia Department of Natural Resources
- Cooperative Extension Service
- University System of Georgia
- Georgia Department of Community Affairs
- Georgia Urban Agriculture Coalition

The final pre-drought strategy encourages outdoor watering restrictions (detailed in the 'drought responses' section), by assigning days to even and odd addresses, in all but exempt uses (noted below).

2. Local/Regional Actions

The State of Georgia recommends that local and regional governments take four steps to prepare for a future drought. Like state government, local governments are encouraged to develop a drought communications system that will allow information to efficiently move from government to local water providers to the public. The local governments are also encouraged to draft their own drought management and conservation plan, taking into consideration local conditions that may not be addressed at larger scales of planning. Local governments should assess and classify the vulnerability of all individual water systems. Finally, local governments should define drought responses, with water use restrictions being at least as severe as the state requirements.

Drought Responses

"'Drought responses' are shorter-term actions, implemented during a drought, according to the level of drought severity.

1. Outdoor Watering Reduction Schedule

Georgia can declare a drought a level of severity (1–4, with one being least severe), across one or more climate divisions, depending on the conclusions of the Drought Response Committee. Once a drought is declared, watering is restricted to a schedule determined by address. Odd-numbered address can only water on Tuesdays, Thursdays, and Sundays. Even-numbered addresses can only water on Mondays, Wednesdays, and Saturdays. Drought Stage 1 and 2 will restrict outdoor watering to late-evening/early-morning hours on scheduled days. Drought Stage 3 will only allow watering on the scheduled weekend day. Declared Drought Stage 4 will enact a complete ban on all outdoor water use. This is also known as the "basic schedule."

There are several landscape exemptions to this rule:

- Golf course greens and tees may apply for exemption on fairway restrictions if irrigating with recycled wastewater,
- Landscapes utilizing small capacity wells not regulated by the EPD'
- Newly installed landscapes (30 days),
- Personal gardens.

Other outdoor water uses have special conditions. The following activities are restricted to the basic schedule, except drought levels 3 and 4, in which they are banned:

- Filling installed swimming pools, except when necessary for structural integrity or health care,
- Non-commercial fund-raisers (car washes, etc.),
- Ornamental water use like fountains and reflecting pools, unless supporting aquatic life,
- Washing buildings or structures, except for immediate fire protection.

The washing of hard surfaces (streets, gutters, sidewalks) must follow the basic schedule for level 1, but are restricted thereafter unless an instance of public safety arises. The use of fire hydrants for any purpose besides firefighting, flushing, or public safety is prohibited in all drought levels.

2. Commercial Uses Exempt from Outdoor Water Use

The following people (in a commercial environment) are exempt from the basic schedule restrictions:

- Car washes
- Construction sites

- Food and fiber producers
- Fruit and vegetable growers
- Ornamental growers
- Professionally licensed landscapers/golf course contractors/sports turf landscapers
- Retail garden centers
- Sod producers

Hydro-seeding, power washing, and act ivities essential to daily business are exempt, as well. Local restrictions may override these exemptions in declared drought stages 3 and 4.

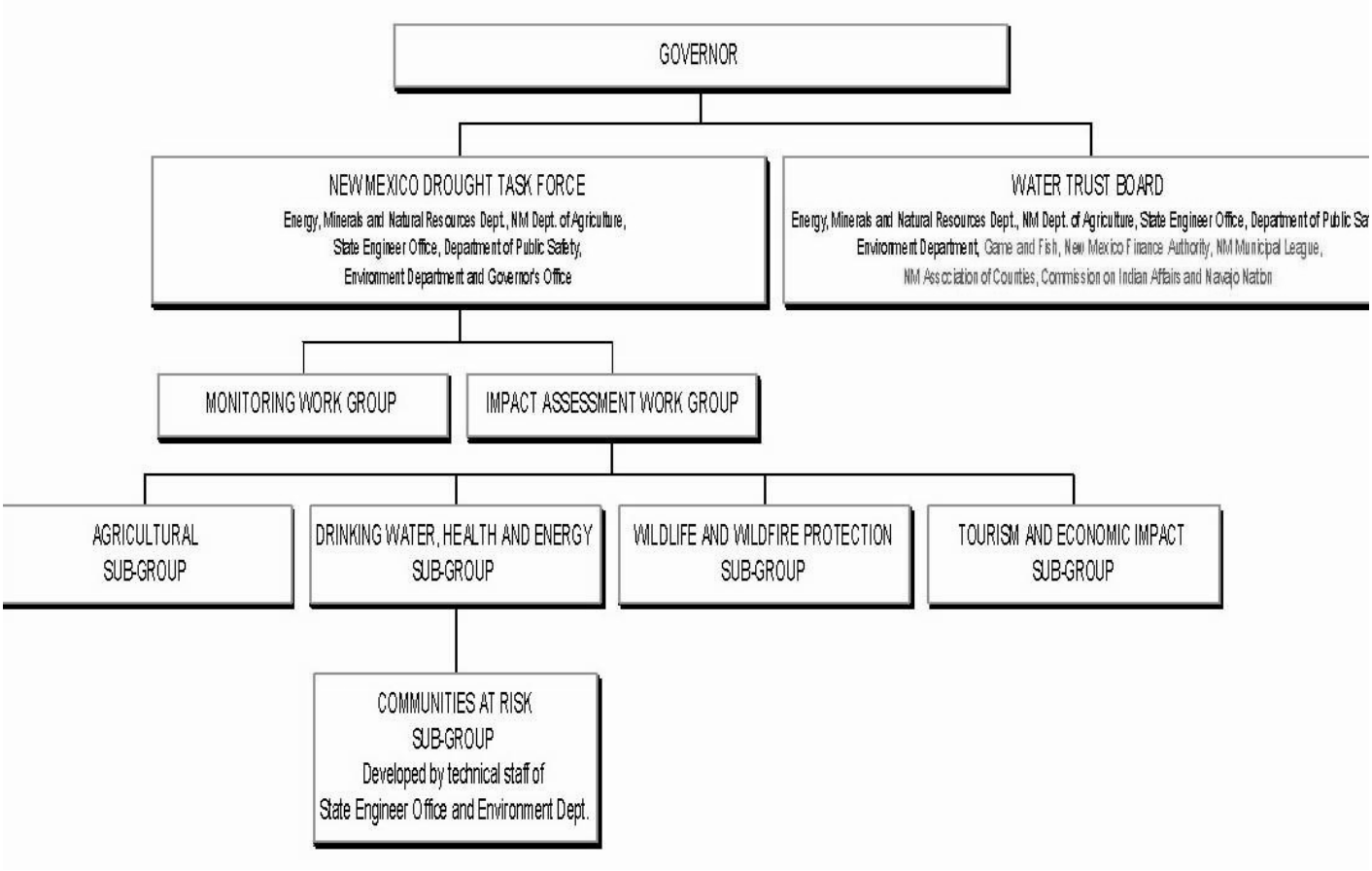
3. Local and Regional Options

Local water supply providers are reminded to contact the EPD or the Georgia Emergenc y Management Agency in the event of emergency. Local authorities also retain the right to go beyond the minimum state requirements and impose more severe restrictions and drought responses in all areas.

Local governments are reminded that a proper drough t response plan includes pricing strategies to encourage conservation and discourage water use. Several state agencies are available for guidance on these strategies (elimination of flat pricing, rewards for decreased usage, penalties for increased usage, etc.).

Appendix C: New Mexico Drought Plan

C1. New Mexico Drought Task Force and Work Group Structure .



C2. New Mexico Drought Status Levels and Associated Drought Index Levels .

Increasing Drought Severity

Decreasing Drought Severity

Drought Triggers	
Drought Status	**Characteristics for a Single Climate Region**
Normal	PDSI between -.9 and + 5.0, Six month SPI positive.
Advisory (approaching or experiencing incipient drought)	One month or 4 week running average PDSI is between -1.0 and -1.9 but period of less than -1.0 does not exceed 2 months. Six month SPI declining and less than 0.25 for 2 consecutive months.
Alert (mild drought)	PDSI is between -1.0 and -1.9 for greater than 2 months or between -2.0 and -2.9 for 1 month. Six month SPI between 0 and -.99 .
Warning (moderate drought)	PDSI is between -1.0 and -1.9 for 9 months or more, -2.0 to -2.9 for at least 2 months, or -3.0 or less for at least 1 month. Six month SPI declining and between -1.00 and -1.49 .
Emergency (severe to extreme drought)	PDSI is between -2.0 to -2.9 for 9 months or more, -3.0 to -3.9 for at least 2 months, or -4.0 or less for at least 1 month. Six month SPI declining and less than -1.5 .
Emergency (drought receding)	After severe to extreme drought criteria has been met, PDSI improves to greater than -2.0 for 2 consecutive months. Six month SPI turns in positive direction for two consecutive months.
Warning (drought receding)	After criteria for moderate or worse drought has been met, PDSI improves to greater than -1.5 for 2 consecutive months. Six month SPI rising in positive direction and between -1.00 and -1.49 for two consecutive months.
Alert (drought receding)	After criteria for mild or worse has been met, PDSI improves to greater than -1.0 for 2 consecutive months. Six month SPI rising in positive direction and between 0.0 and -.99 for 2 consecutive months.
Advisory (drought receding)	After criteria for mild or worse drought has been met, PDSI improves to greater than or equal to zero, and the 10 month running total of the PDSI is less than -10.0 . Six month SPI value above zero.

C3. New Mexico IAWG Actions Dependent on Drought Status a nd Trend.

Increasing Drought Severity

Decreasing Drought Severity

Drought Stage	Impact Assessment Work Group (IAWG)
NORMAL	Sub-groups meet quarterly to coordinate implementation of "**Planned Mitigation Actions**." Submit "**Drought Impact Action Report**" to the DTF annually.
ADVISORY APPROACHING OR EXPERIENCING INCIPIENT DROUGHT	Upon receipt of an "**Drought Advisory Notice**" from the MWG, sub-group chairs will meet to organize contingency actions in case conditions deteriorate. Sub-groups continue to meet quarterly to coordinate implementation of "**Planned Mitigation Actions**" and submit "**Drought Impact Action Report**" to the MWG, IAWG and DTF annually.
ALERT MILD DROUGHT	Within 1 week of "**Drought Alert Notice**," sub-groups meet to make initial assessment of their sector's impacts/potential impacts and report findings to IAWG. IAWG compiles "**Impact Action Report**" and submits to MWG and DTF.
WARNING MODERATE DROUGHT	Upon receipt of "**Drought Warning Notice**," the sub-groups will meet to update **"Impact Action Report"** and implement response actions within capabilities of participants, propose appropriate responses outside their authority and report any unmet needs or recommendations to the DTF in the "**Impact Action Report**," which shall be updated monthly. Begin to assemble data necessary to support Governor's request for Presidential Emergency or Agricultural Disaster Declaration by U.S. Agriculture Secretary. Submit to DTF when data warrants declaration.
EMERGENCY SEVERE TO EXTREME DROUGHT	Continue to assemble and submit to DTF data necessary to support Governor's request for Presidential Emergency or Agricultural Disaster Declaration by U.S. Agriculture Secretary. The subgroups will continue to meet on a monthly basis and update the '**Impact Action Report,**" implement response actions within capabilities of participants, propose appropriate responses outside their authority and report any unmet needs or recommendations to the DTF.
EMERGENCY RECEDING	As necessary, continue to assemble and submit to DTF data necessary to support Governor's request for Presidential Emergency or Agricultural Disaster Declaration by U.S. Agriculture Secretary. The-sub groups will continue to meet on a monthly basis and update the '**Impact Action Report**" and implement or propose appropriate response actions and report any unmet needs or recommendations to the DTF.
WARNING RECEDING	As necessary, continue to update "**Impact Action Report"** and implement or propose appropriate response actions within capabilities of participants and report any unmet needs or recommendations to the DTF.
ALERT RECEDING	Sub-groups continue to assess impact on sectors and report findings to IAWG, as necessary. Begin assessment for '**IAWG After Action Evaluation Report**"
ADVISORY RECEDING	Sub groups will meet quarterly to resume coordinated implementation of '**Planned Mitigation Actions** ." '**Drought Impact Action Report**" to be submitted to the DTF annually. Compile "**IAWG After Action Evaluation Report**" (that includes any recommended changes) and submit it to DTF.
NORMAL	Sub-groups meet quarterly to coordinate implementation of "**Planned Mitigation Actions** " Submit "**Drought Impact Action Report**to the IAWG and DTF annually.

Appendix D: Montana Drought Plan

D1. Issues Identified by the Steering Committee Responsible for Drafting the Original Drought P lan.

December 1990
The following selected passages from the final plan section on drought management are included for a review of the issues identified by the steering committee and its recommendations for achieving them.

Issue 1: Drought Monitoring and Early Warning
Recommendations:

1) Pursue the calculation of the Palmer Drought Severity Index (PDSI) for smaller geographical areas.
2) Encourage the continued development and revision of basin -specific Surface Water Supply Indices (SWSIs).
3) Improve data collection and forecasting by getting the information to those who are vulnerable to drought.

Issue 2: Impact Assessment
Recommendation:

1) Coordinate the efficient and timely assessment of impacts related to various water uses. A list of the individuals with the expertise to assess impacts should be maintained.

Issue 3: Coordination of Governmental Actions
Recommendations:

1) Replace the current drought plan, by directive of the governor, with a document that incorporates the recommendations of the state water plan.
2) Reassign the responsibility for state drought management coordination from the DES to the DAC.

Issue 4: Triggering Mechanisms
Recommendations:

1) The drought plan should recommend specific actions corresponding to numerical indicators of drought severity.
2) In addition to the PDSI and SWSI, other type s of data should be used to indicate the onset and severity of drought.

Issue 5: Assistance programs
Recommendations:

1) Update the list of state and federal assistance programs in the state drought plan.
2) Provide technical and financial assistance to lo cal drought advisory committees (LDACs) for promoting drought preparedness.
3) Encourage producers to apply to the Federal Crop Insurance Program . For example, federal disaster assistance was made available to over 30 counties this year as a result of losses.

Issue 6: Funding for Drought Management Programs
Recommendation:

1) Apply for grant fu nding for a pilot program in drought management.

Issue 7: Research and Educational Programs

Recommendations:

1) Encourage the use of existing educational programs for drought awareness.
2) Support ongoing research into ways to improve drought monitoring, assess ment, and mitigation.
3) Publish and distribute a comprehensive annotated directory of available educational resources about water conservation.
4) Make better use of the media for informing the public about drought management options and activities.

Issue 8: Drought Mitigation Strategies
Recommendations:

1) Increase the educational emphasis given to forest and range management practices for the minimizing of drought impacts.
1) Inventory operating plans of reservoirs to ensure drought contingency plans.
2) Develop and implement drought plans for state -funded reservoirs.
3) Establish stronger economic and other incentives for private investments in water conservation.
4) Consider feasible water storage where it will increase water supply security.
5) Consider basin closure by peti tion of local water users to avoid aggravation of water shortage situations and over -appropriation.
6) Encourage voluntary water conservation by domestic, municipal, and industrial users.
7) Clarify state law so that water rights holders who conserve water are c learly allowed to sell or lease salvaged water in a manner that does not adversely affect water rights.
8) Improve water conveyance efficiencies in agricultural, municipal, and industrial uses.
9) Clarify state law to allow voluntary, temporary changes of water rights and contract water exchanges.
10) Urge the Board of Natural Resources and Conservation to adopt rules for the installation of water metering devices to resolve conflict on water short drainages.
11) Find ways to expedite the resolution of water use conflict s and water rights enforcement during drought.
12) Develop a model water conservation ordinance for use by municipalities and rural domestic water suppliers.

D2. Agencies and Organizations Involved in the Montana Drought P lan.

State Agencies
Bureau of Mines and Geology
Department of Agriculture
Department of Commerce
Department of Environmental Quality
Department of Fish, Wildlife, and Parks
Department of Livestock
Department of Military Affairs
Department of Natural Resources and Conservation
Disaster and Emergency Services Division
Governor's Office
Montana School of Mineral Science and Technology
Montana State Library
Montana State University
Natural Resource Information System

Federal Agencies
Army Corps of Engineers
Bureau of Land Management
Bureau of Reclamation
Consolidated Farm Service Agency
Federal Crop Insurance Corporation
Federal Emergency Management Agency
Geological Survey
National Weather Service
Natural Resource Conservation Service
Small Business Administration

Local Organizations
City County Planning Offices
Cooperative Extension Service
County Disaster and Emergency Services
County Food and Agricultural Committee
Local Drought Advisory Committees